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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. |
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| 86/257,721 | 03/25/97 | GESSERT | MEL 96-48 |

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| EXAMINER |
|------------|
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| ART UNIT | PAPER NUMBER |
|----------|--------------|
| 2812 | 0 |

DATE MAILED: 03/15/99

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary

Application No.
08/937,721

Applicant(s)
Gessert

Examiner
S. Mulpuri

Group Art Unit
2812



☒ Responsive to communication(s) filed on Dec 21, 1998

☒ This action is **FINAL**.

☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire 3 month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claims

☒ Claim(s) 1, 2, and 4-6 is/are pending in the application.

Of the above, claim(s) _____ is/are withdrawn from consideration.

☐ Claim(s) _____ is/are allowed.

☒ Claim(s) 1, 2, and 4-6 is/are rejected.

☐ Claim(s) _____ is/are objected to.

☐ Claims _____ are subject to restriction or election requirement.

Application Papers

☐ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on _____ is ☐ approved ☐ disapproved.

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some* ☐ None of the CERTIFIED copies of the priority documents have been
☐ received.

☐ received in Application No. (Series Code/Serial Number) _____

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

☐ Notice of References Cited, PTO-892

☐ Information Disclosure Statement(s), PTO-1449, Paper No(s). _____

☐ Interview Summary, PTO-413

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

--- SEE OFFICE ACTION ON THE FOLLOWING PAGES ---

Art Unit:

DETAILED ACTION

Claims 1-2, 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Admitted Prior Art in combination with Schroen et al.

Rejection is maintained same as in paper no. 3, mailed on 10/15/98.

Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Admitted prior Art in combination with Schroen et al as applied to claims 1-2, 4 above, and further in view of Lee et al.

Rejection is maintained same as in paper no. 3, mailed on 10/15/98. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Admitted prior Art in combination with Schroen et al as applied to claims 1-2, 4 above, and further in view of Ebe et al.

Rejection is maintained same as in paper no. 3, mailed on 10/15/98.

Applicant showed the technical meaning of aperture as response to over USC 112 rejection. However, it is suggested to add diameter to show the specificity from other shaped apertures.

Response to the applicant arguments:

Applicant's arguments filed on 3/15/98 have been fully considered but they are not persuasive. Applicant argue that Admitted Prior Art does not teach a dry process for providing uniform and reproducible surface of low resistance electrical contact between a metal layer and layer of p-CdTe surface of a semiconductor. However, Admitted Prior art discloses both wet etch treatment and ion bombardment otherwise called as dry process (see page 6, line 6-10) to remove the contamination over the surface of the II-VI compound semiconductor substrates such

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as CdTe or HgCdTe surfaces(see from page 5- to page 6 until line 14). Moreover, secondary reference Schroen et al disclose a method of creating Ar ions and irradiating created Ar ions for as low as 5 minutes on polycrystalline, doped II-VI compound semiconductor, and also discloses irradiating time depends on the dose, energy and distance between target and electrode(col. 4, line 63-68, col. 5, lines 1-2) . The choice of selecting distance between target and source and time would have been well with in the scope of one of ordinary skill in the art depending on the desired result as choice given by Schroen et al. Schroen et al especially teaches applying Ar ions on the polycrystalline semiconductor materials, and II-VI compound semiconductors(see col. 6, lines 25-60). Admitted Prior Art, as modified by Schroen et al, would have low contact resistance due to cleaning effect of surface.

Applicant argue that Schroen et al exposing the semiconductor body to glow discharge in the presence of inert gas. However, Schroen et al clearly disclose exposing the semiconductor body to Ar ion bombardment for surface cleaning and activation(see abstract, lines 23-25).

Applicant further argue that Schroen et al teach crystalline silicon not polycrystalline CdTe and emphasize that Schroen demonstrates only crystalline material of silicon and silicon oxidizes and forms stable oxide, which is non-reactive most metals. However, the teaching of Schroen et al is relied on cleaning step of surface of the compound semiconductor with Ar ions. Schroen et al clearly mention wide range of semiconductor material such as Si, Ge, GaAs, GaAlAs, GaAsP and various other compound semiconductors of binary and ternary types, including II-VI compound semiconductors. Schroen et al teaches that it is necessary to apply Ar ions to reduce the surface

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states certain semiconductors, which has higher surface states than Si (see col. 2, lines 49-59). It is well known that CdTe has more surface states due to the presence of surface vacancies than Si because CdTe is II-VI binary compound semiconductor and does not meet the stoichiometry at the surface due to affect of process steps.

Applicant argues that applicant invention is directed to use of ion-beam process to condition a polycrystalline p- CdTe prior to the additional semiconductor layer. However, such limitation of forming additional semiconductor layer subsequent to Ar ion irradiation is not recited in the claims. Claim is only limited to forming low-resistance electrical contact between metal layer and a layer of p-CdTe surface.(see MPEP 2145, section f).

Applicant argues that Schroen et al uses 1-10 keV glow discharge , which is high voltage and high pressure is vastly different from the 0.05-2 keV ion-beam exposure. However, claimed conditions of voltage and pressure are met by the teaching of Schroen et al, where in pressure 5×10^{-7} torr and voltage 1000 volts are within the limits of claimed range.

Applicant argues that the improvement of the interfacial transport at the interface of the CdTe is improved by the alignment of the valence bonds between conductors, where as improvement in current transport is of Si/oxide/metal in Schroen et al is by creation of semiconductor-insulator interface with stable electrical properties to create an accumulation in the adjacent semiconductor. However, the claim is limited to clean the surface of the p-CdTe layer with Ar ions but not limited subsequent semiconductor layer formation. Schroen et al obtain low contact resistance due to synergistic effect of both cleaning with Ar ions and thin oxide as low as

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10 angstroms. Moreover, open language "comprising" does not preclude the claimed process from having additional process steps. Conclusively, claimed conditions are met by Admitted prior art in combination with Schroen et al.

Applicant argues that Lee et al is directed to an external plasma gun that provides both ions and electrons for bombarding surfaces and no reference to or acknowledgment of the use of external plasma gun to condition a polycrystalline p-CdTe surface prior to deposition of an additional semiconductor layer. However, Lee et al is relied on the teaching of plasma apparatus with aperture diameter 3 cm for effective Ar ion irradiation. Modified invention Admitted prior Art in combination with Schroen et al and Lee et al would have aperture diameter of 3 cm for bombarding Ar ions on the substrates. As mentioned before, instant claims are not limited to forming semiconductor layer on the surface of the substrate subsequent to Ar ion bombardment.

Applicant argues that the teaching of the Ebe et al is non-related to the teachings of admitted Prior Art and Schroen et al. But Abe et al is relied only on irradiating Ar ions at an angle incidence of 45 degrees to the target to reduce the amount of oxygen on the surface of the film, but not the type of target (see col.2, lines 28-33). Ebe et al particularly teaches 45 degree angle argon irradiation is preferred, when taking the efficiency of sputtering into account for obtaining smooth film surface(see col. 5, lines 28-42, 62-67). Ebe et al further discloses change in the angle depends on the kind of inert ions and material of the substrate. The purpose of the both invention of Schroen et al and Abe et al is to reduce contaminants by using Ar ion irradiation,

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hence the teaching of Ebe et al is analogous art. Art is analogous when it solves the same problem as applicant. In re Melin 165 USPQ 168 (CCPA 1970).

Applicant's arguments that the individual references do not disclose the entire invention are not persuasive since the references are used in combination in a rejection under 35 USC § 103 as teaching certain aspects of the instant invention.

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Swann discloses angle Ar ion implantation(see col. 2, lines 32-43).

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to S. Mulpuri whose telephone number is (703) 305-5184. The fax phone number for the organization where this application or proceeding is assigned is (703) 305-3432.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-5184.


S. Mulpuri

Patent Examiner

Patent Examiner 2800

SM

3/8/99